

Automated Traffic Signal Performance Measures

HELPING TRAFFIC ENGINEERS MANAGE DATA TO MAKE BETTER DECISIONS

PRESENTED BY AMANDA STEVENS, P.E. 3/31/14

What is TIG?



- **AASHTO TECHNOLOGY IMPLEMENTATION GROUP**
- **ACCELERATED ADOPTION VIA TECH ASSISTANCE AND SHARED RESOURCES**
- **HIGH-PAYOFF, MARKET-READY TECHNOLOGIES**

Who are the Lead States for TIG's Automated Signal Performance Measures?



- **INDIANA**



- **MINNESOTA**



- **UTAH**



Pooled Fund Study 5(258):



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Study Detail View

Traffic Signal Systems Operations and Management

General Information

Study Number: TPF-5(258)

Status: Cleared by FHWA

Lead Agency: Indiana Department of Transportation

Contract Start Date:

Est. Completion Date:

Partners: City of Chicago , CA , GA , KS , MN , MS , NH , TX , UT , WisDOT

Contract/Other Number:

Last Updated: Oct 18, 2011

Contract End Date:

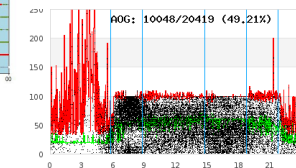
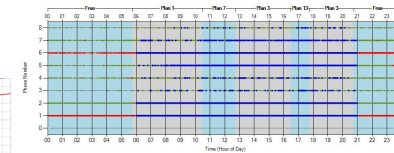
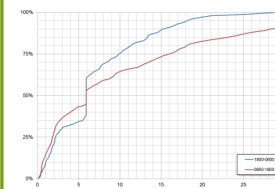
Tools

[Contacts](#)

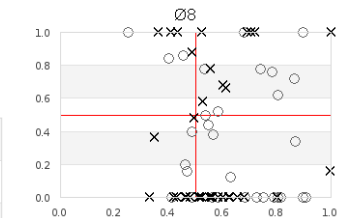
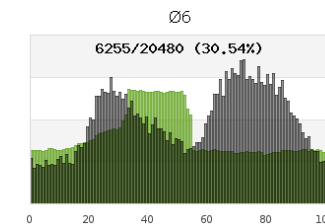
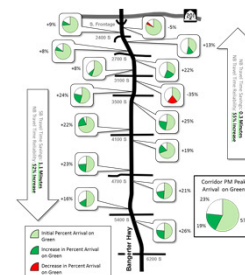
[FAQs](#)

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What are Traffic Signal Performance Measures?



SIGNAL DATA



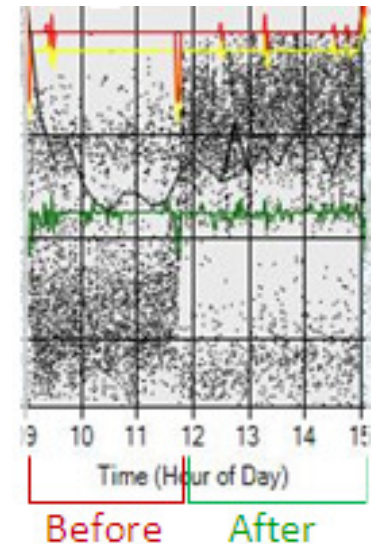
Why Automated Traffic Signal Performance Measures?



Manage Resources



Minimize Traffic Delay



Communicate Results

Active Phase Events:

0	Phase On	Phase # (1-16)
1	Phase Begin Green	Phase # (1-16)
2	Phase Check	Phase # (1-16)
3	Phase Min Complete	Phase # (1-16)
4	Phase Gap Out	Phase # (1-16)
5	Phase Max Out	Phase # (1-16)
6	Phase Force Off	Phase # (1-16)
7	Phase Green Termination	Phase # (1-16)
8	Phase Begin Yellow Clearance	Phase # (1-16)
9	Phase End Yellow Clearance	Phase # (1-16)
10	Phase Begin Red Clearance	Phase # (1-16)
11	Phase End Red Clearance	Phase # (1-16)

Detector Events:

81	Detector Off	DET Channel # (1-64)
82	Detector On	DET Channel # (1-64)
83	Detector Restored	DET Channel # (1-64)
84	Detector Fault- Other	DET Channel # (1-64)
85	Detector Fault- Watchdog Fault	DET Channel # (1-64)
86	Detector Fault- Open Loop Fault	DET Channel # (1-64)

Preemption Events:

101	Preempt Advance Warning Input	Preempt # (1-10)
102	Preempt (Call) Input On	Preempt # (1-10)
103	Preempt Gate Down Input Received	Preempt # (1-10)
104	Preempt (Call) Input Off	Preempt # (1-10)
105	Preempt Entry Started	Preempt # (1-10)

Controller Enumerations

Event Code, Event Description, Parameter

Time: 1:29:51.1
Code: 82 (ON)
Parameter: 5 (Det. Ch.)

Time: 1:30:08.1
Code: 1 (Green)
Parameter: 8 (Phase)

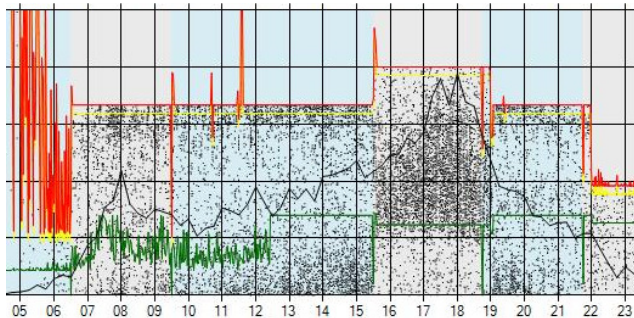
Time: 1:30:15.8
Code: 81 (OFF)
Parameter: 5 (Det. Ch.)

06/27/2013 01:29:51.1	10	8
06/27/2013 01:29:51.1	82	5
06/27/2013 01:29:52.2	1	2
06/27/2013 01:29:52.2	1	6
06/27/2013 01:29:52.3	82	2
06/27/2013 01:29:52.8	82	4
06/27/2013 01:29:52.9	81	4
06/27/2013 01:29:53.3	81	6
06/27/2013 01:29:54.5	81	2
06/27/2013 01:30:02.2	8	2
06/27/2013 01:30:02.2	8	6
06/27/2013 01:30:02.2	33	2
06/27/2013 01:30:02.2	33	6
06/27/2013 01:30:02.2	32	2
06/27/2013 01:30:02.2	32	6
06/27/2013 01:30:06.1	10	2
06/27/2013 01:30:06.1	10	6
06/27/2013 01:30:08.1	1	8
06/27/2013 01:30:13.1	32	8
06/27/2013 01:30:15.8	81	5
06/27/2013 01:30:18.5	82	6
06/27/2013 01:30:27.5	81	6
06/27/2013 01:30:30.4	8	8

High Resolution Data

Timestamp, Enumeration Code, Parameter

Today's Goals:



**Purdue Coordination
Diagram (PCD)**

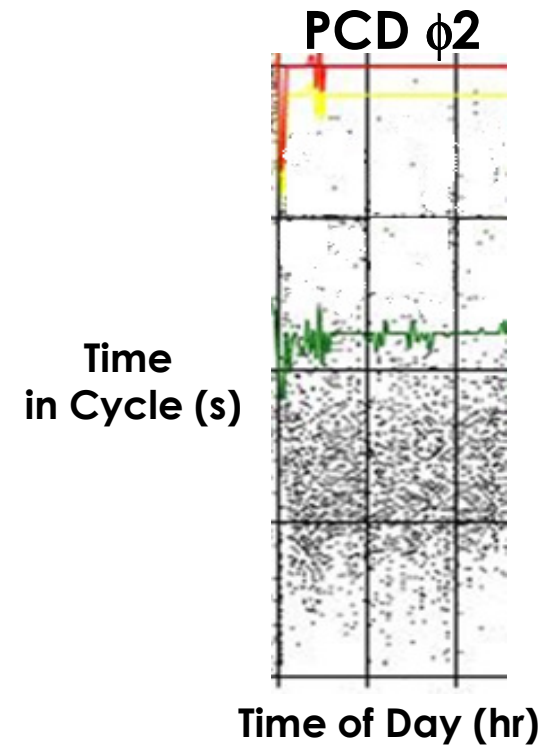
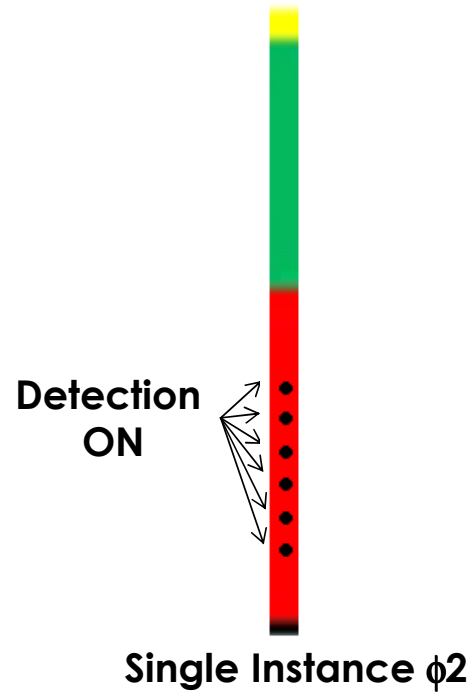


**Performance
Measures for
YOUR Agency**

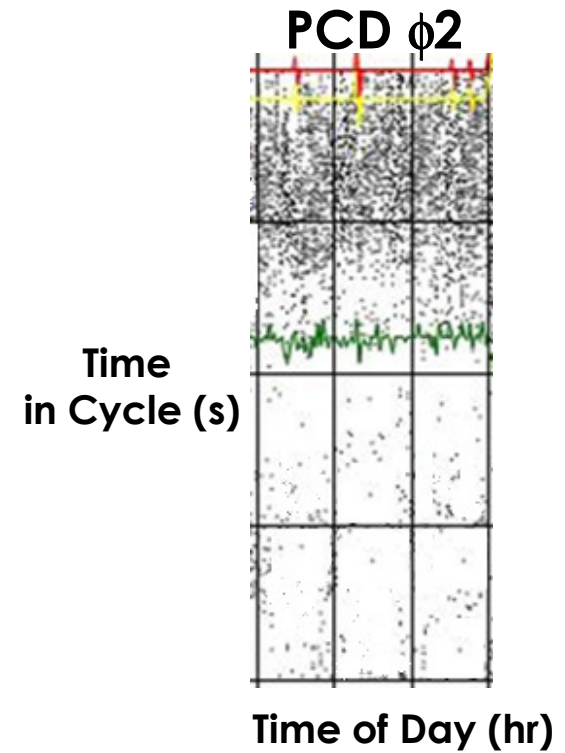
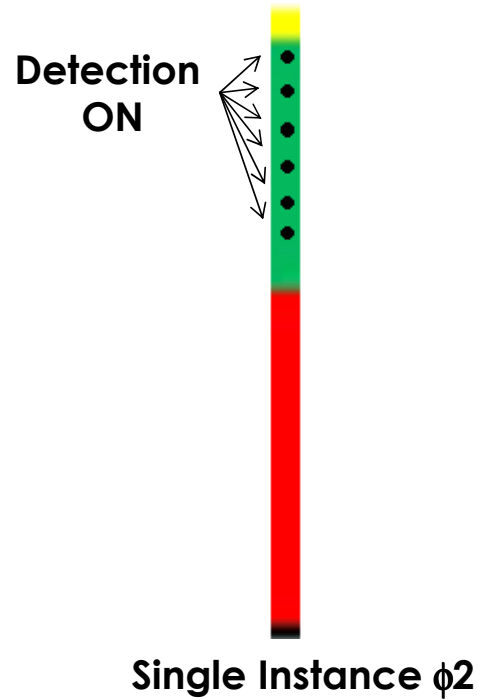
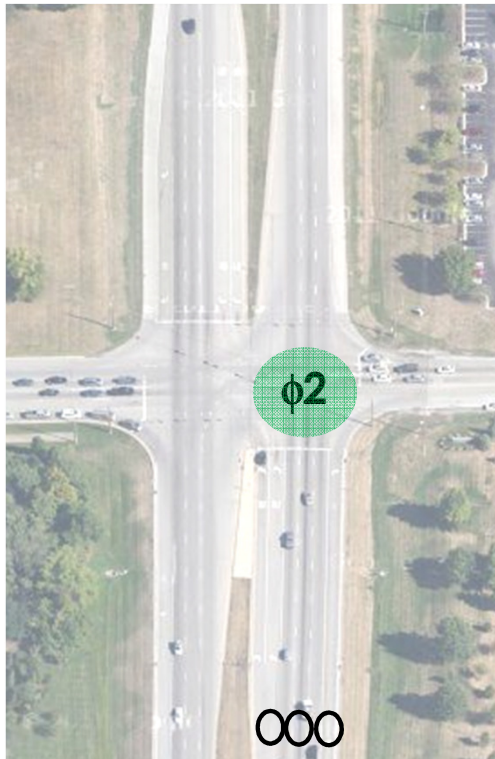


Get Started!

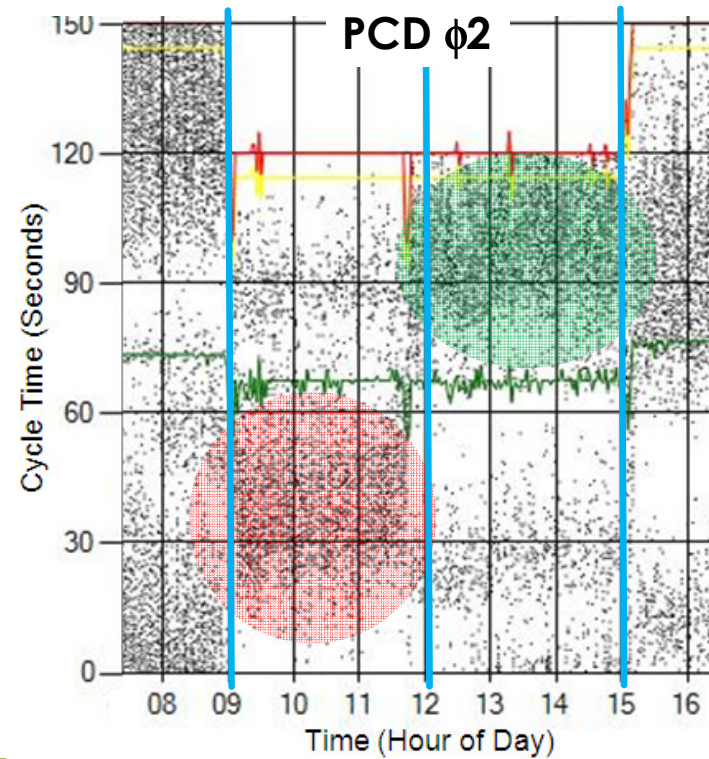




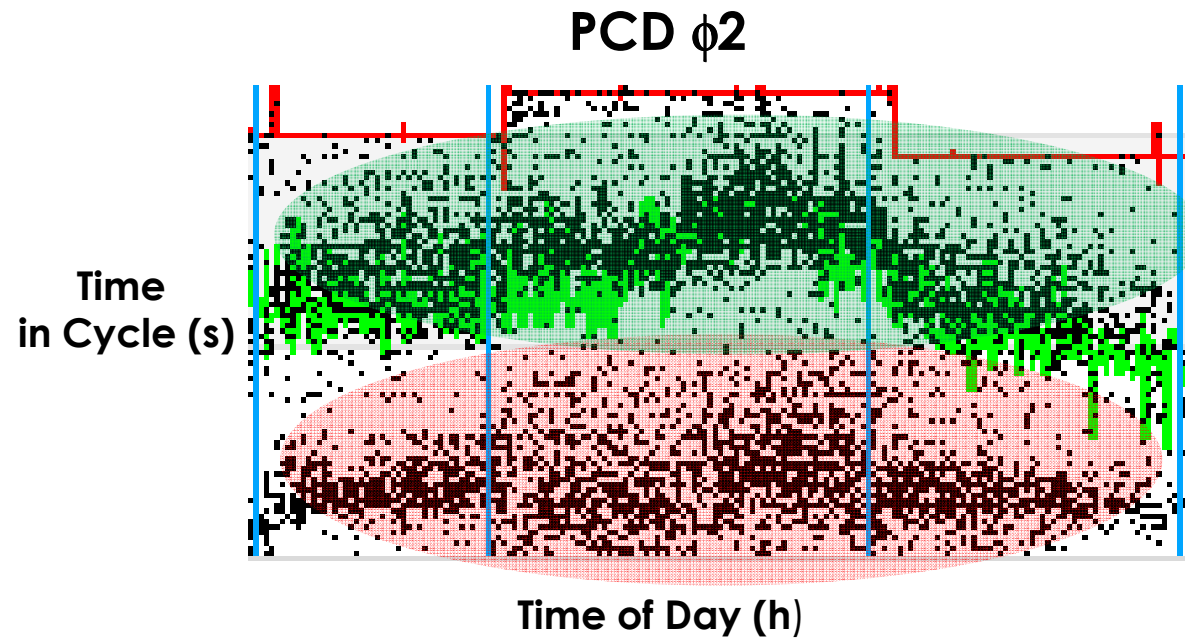
PCD: Red Arrival



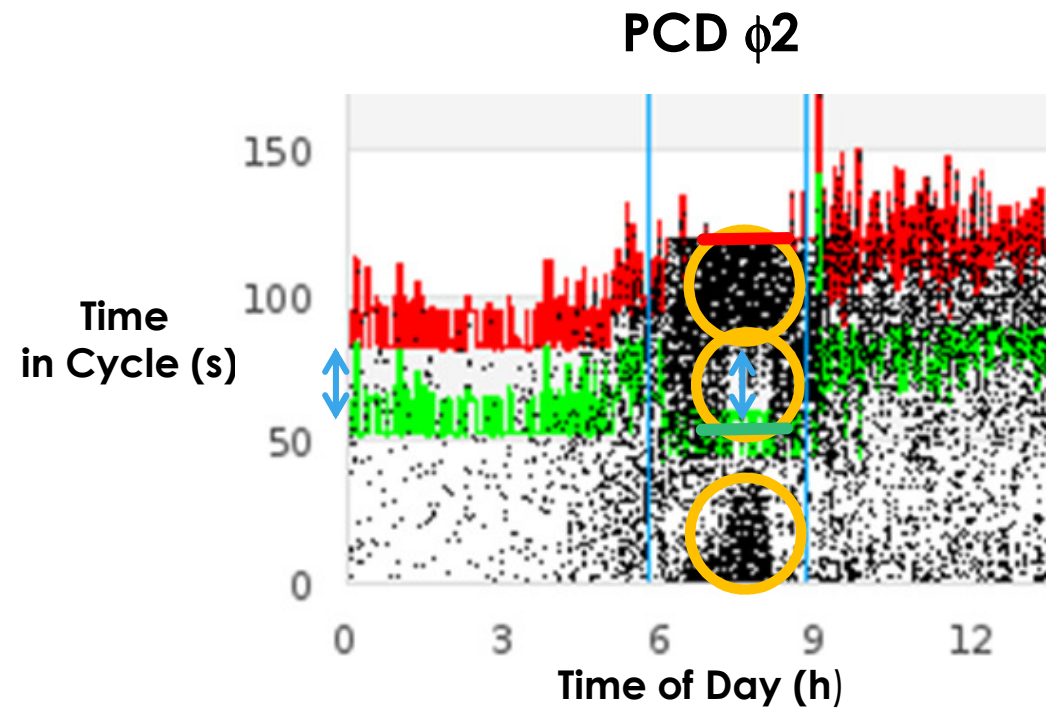
PCD: Green Arrival



PCD: Platoon Arrival by TOD



PCD: Distinct Platoons

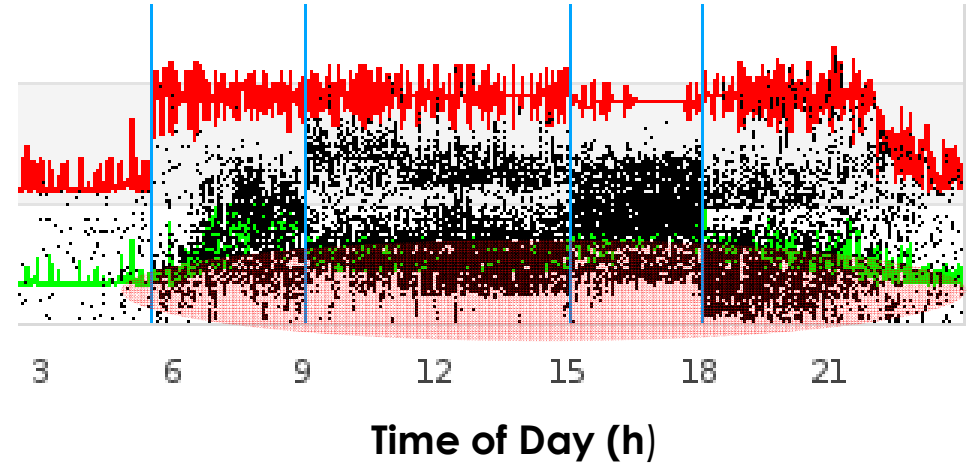


PCD: Cycle Failure

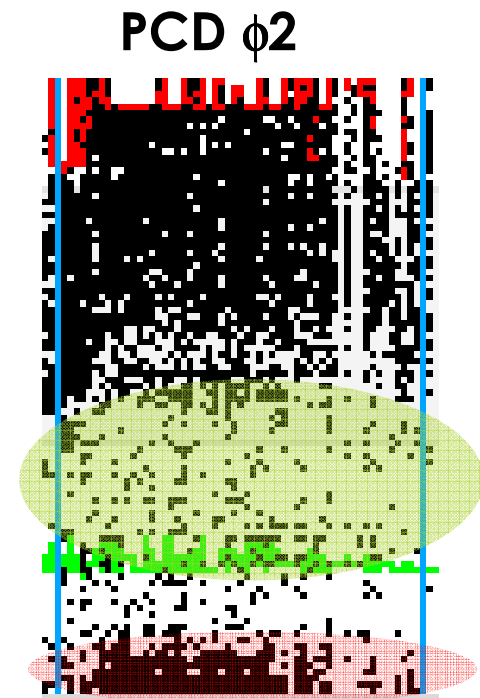


Time
in Cycle (s)

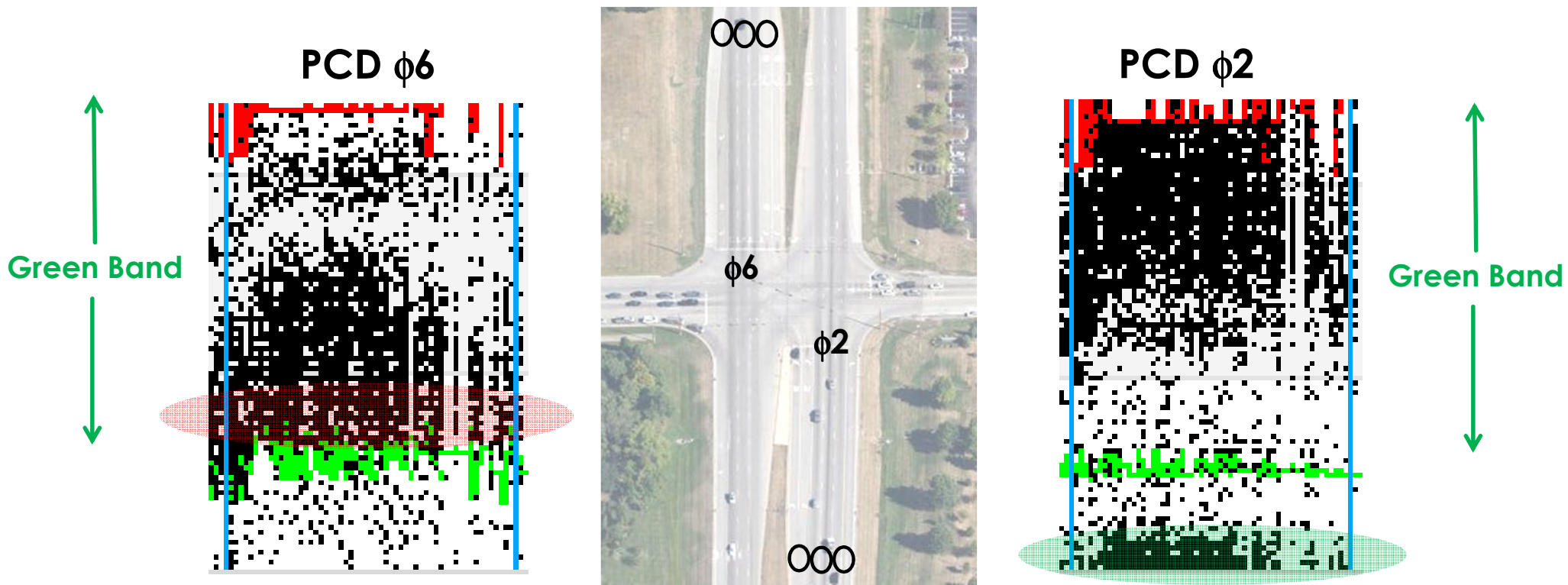
PCD $\phi 2$



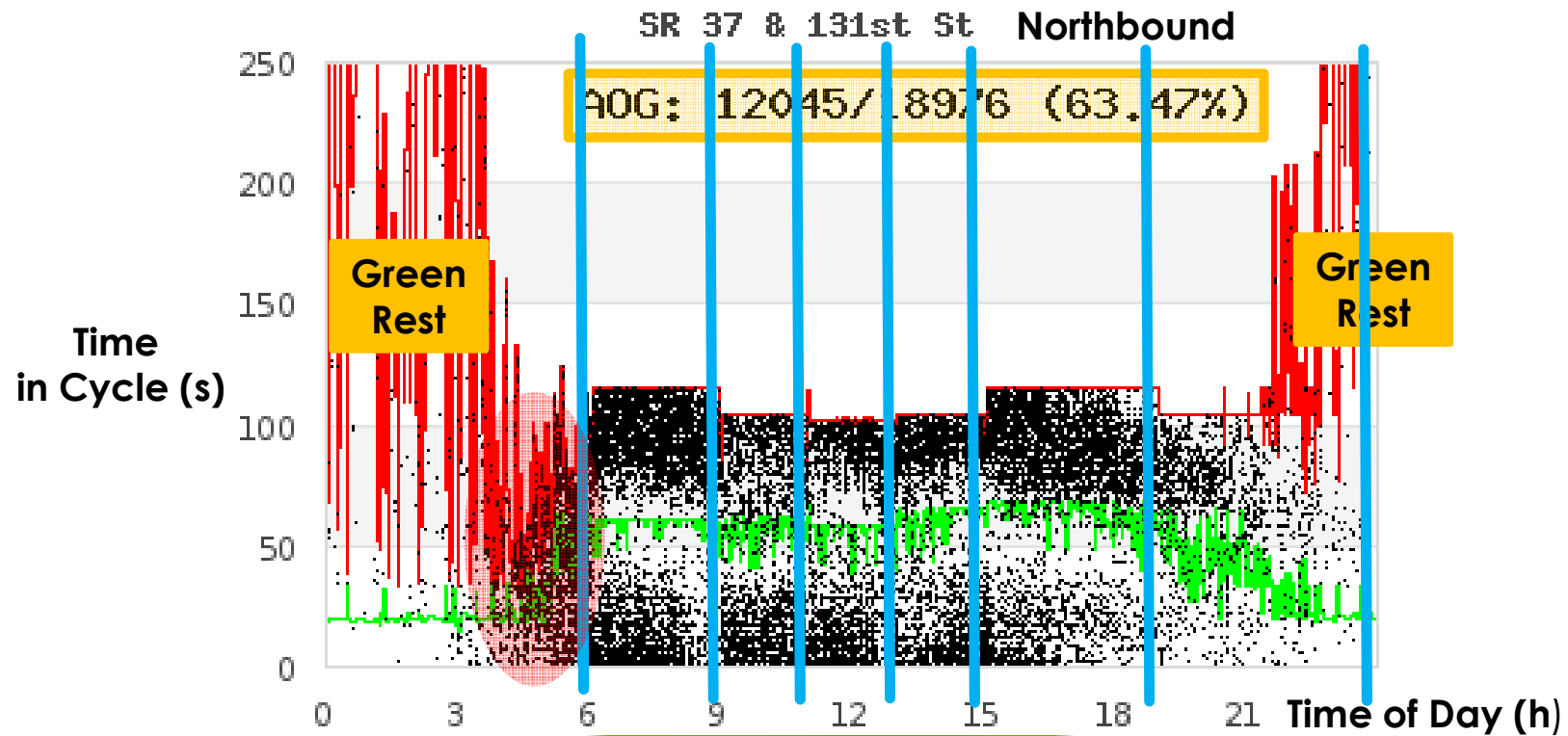
PCD: Early Platoon Arrival



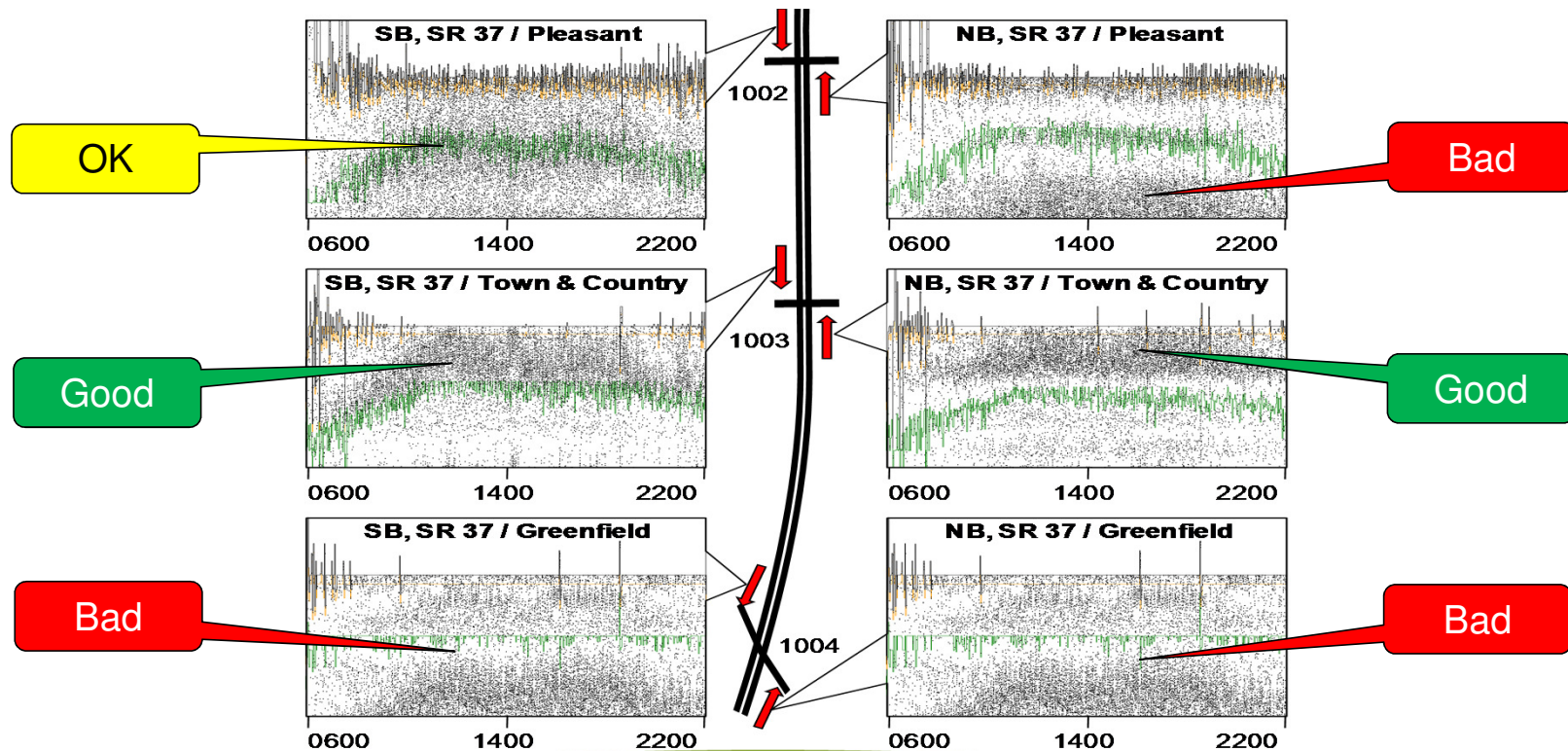
PCD: Platoon Clipping



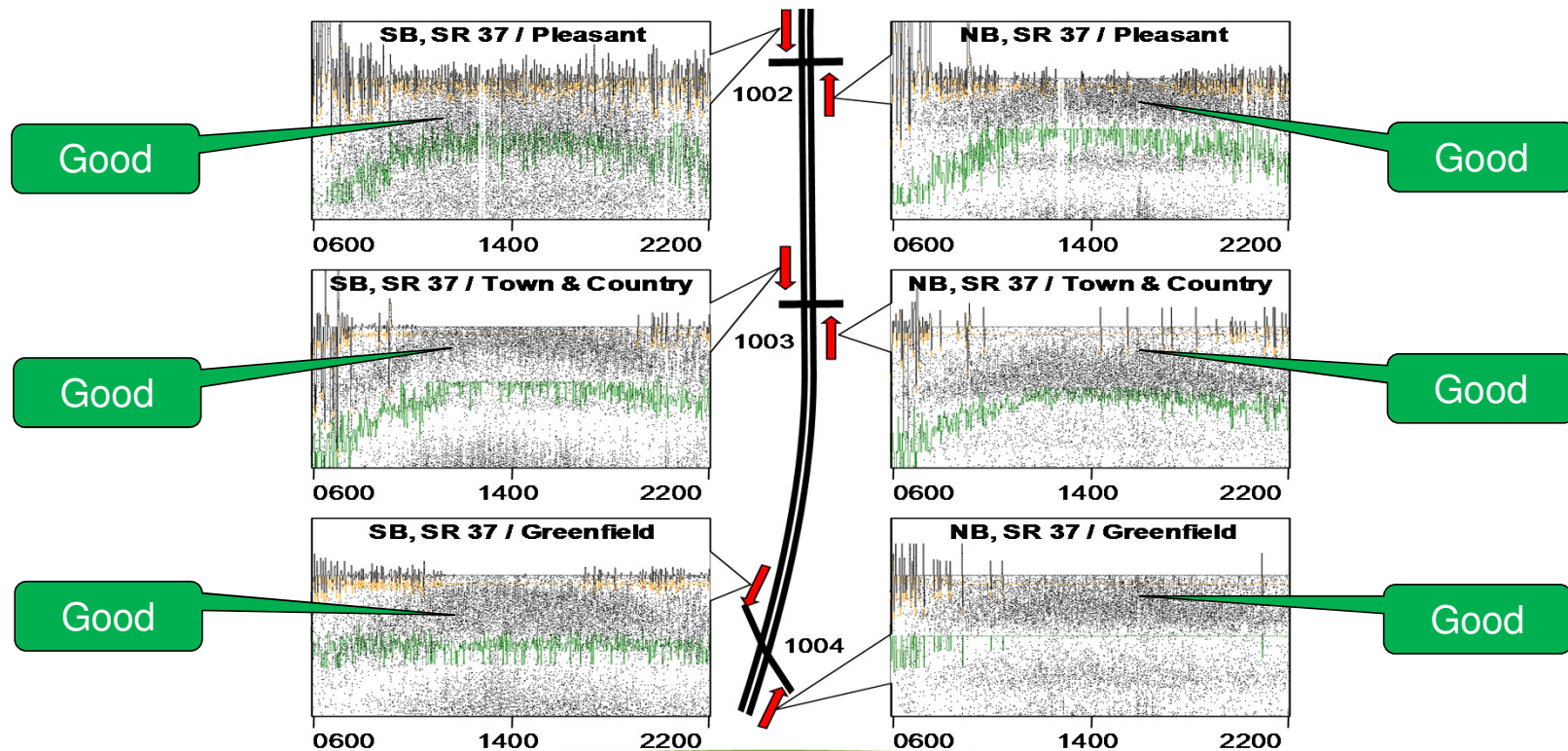
PCD: Adjust Offsets



PCD: Pattern Start & End Times

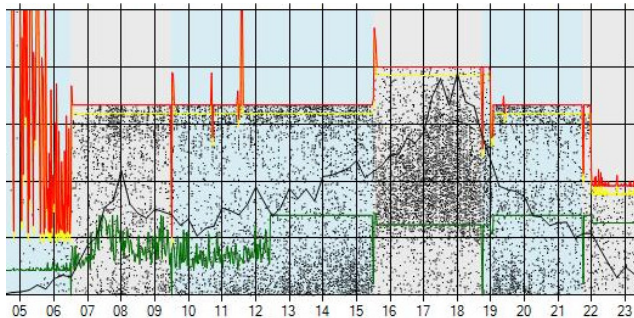


BEFORE Offset Optimization



AFTER Offset Optimization

Today's Goals:



**Purdue Coordination
Diagram (PCD)**



**Performance
Measures for
YOUR Agency**

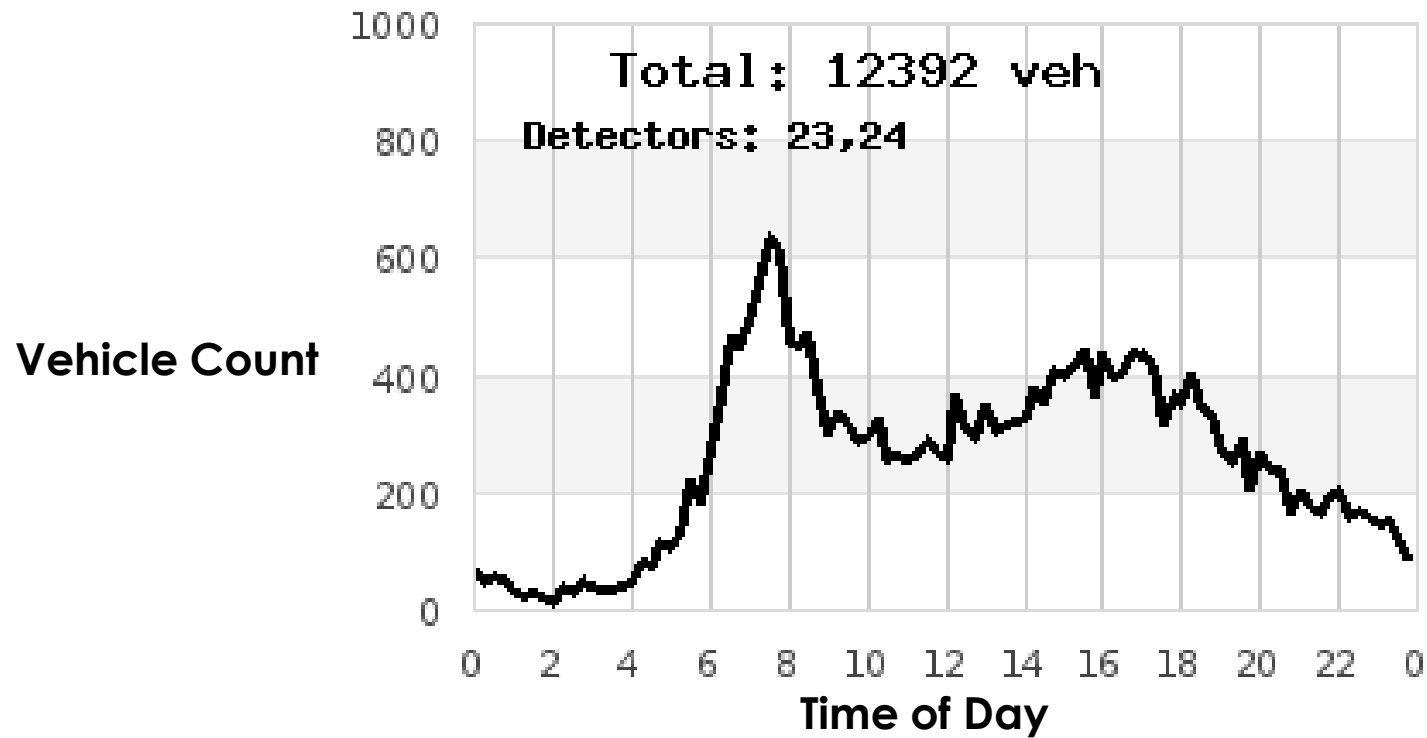


Get Started!

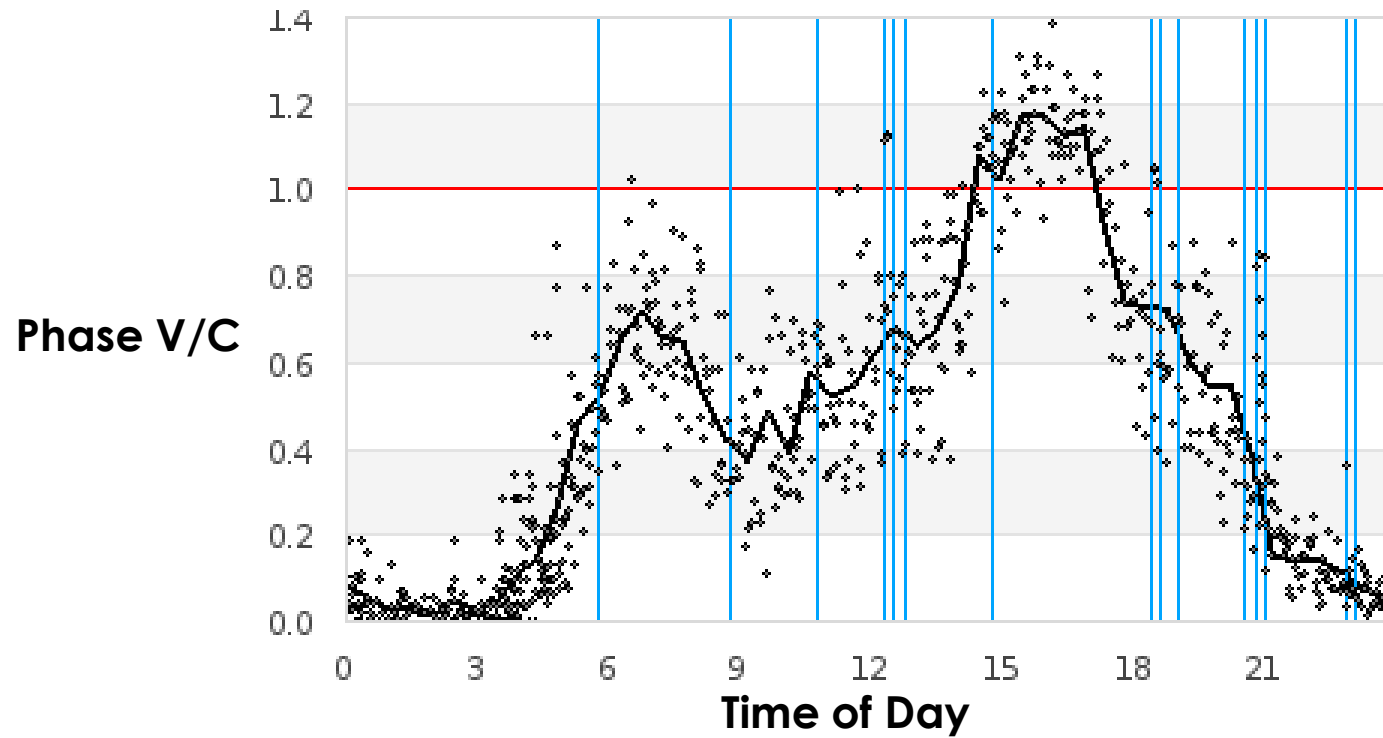
HCM & Signal Performance Measures



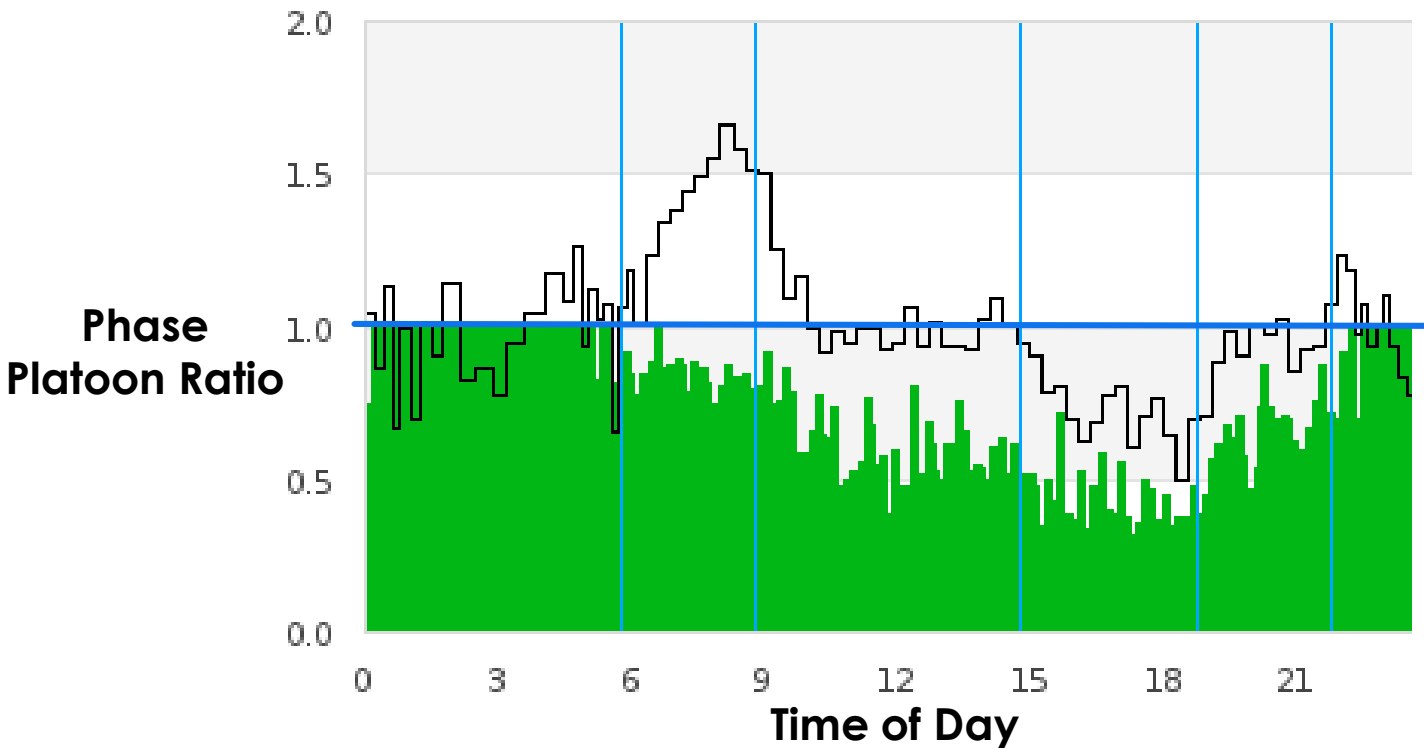
- FLOW RATE
- LEVEL OF SERVICE
- VOLUME / CAPACITY RATIO
- ORIGIN-DESTINATION DISTRIBUTION (FOR CLOSELY SPACED INTERSECTIONS)
- VEHICLE DELAY
- PLATOON RATIO
- QUEUE LENGTH
- PROPORTION ARRIVAL ON GREEN
- PASSAGE TIMES
- VEHICLE SPEED (RADAR OR PROBE DATA)
- LANE UTILIZATION
- PEDESTRIAN/BIKE/PREEMPTION ACTIVITY



Volumes by TOD



Volume to Capacity Ratio



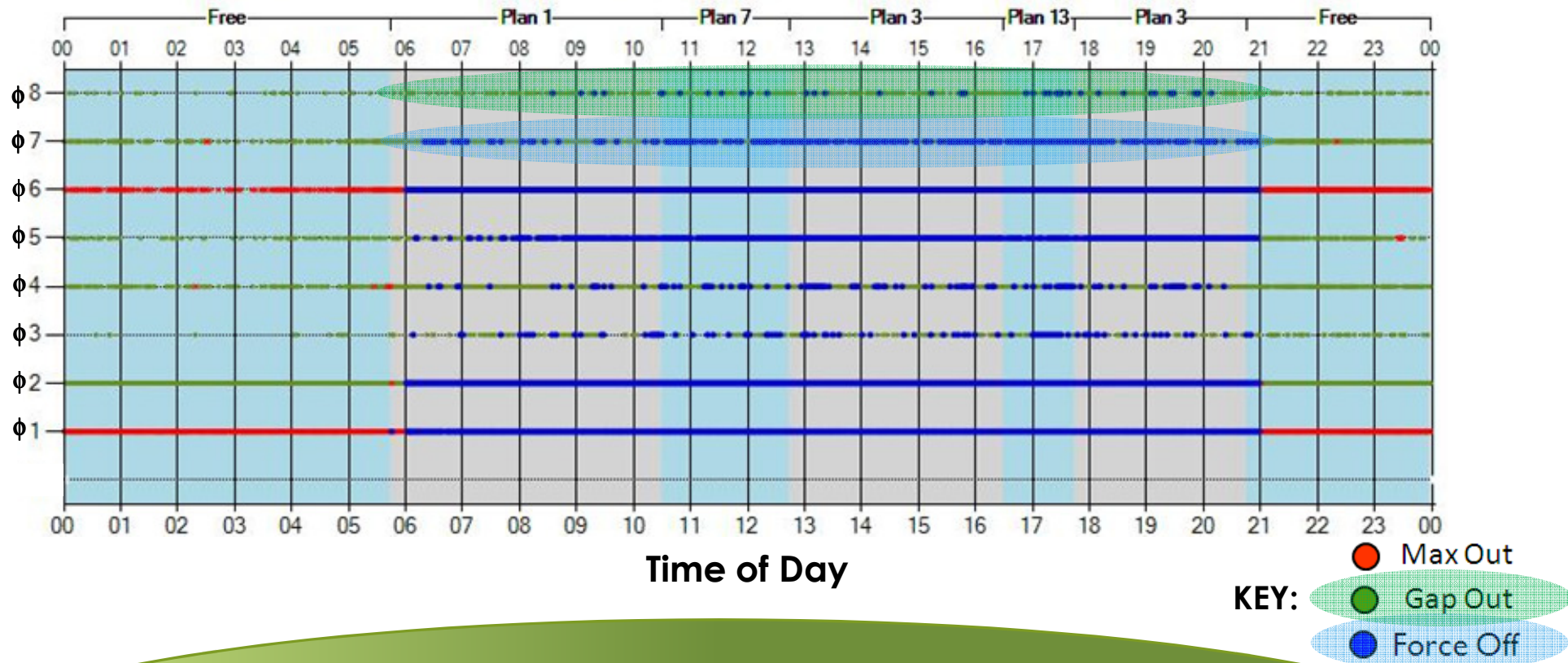
Example Calculations:

$$\frac{75\% \text{ AOG}}{50\% \text{ Green Time}} = 1.5$$

$$\frac{50\% \text{ AOG}}{50\% \text{ Green Time}} = 1.0$$

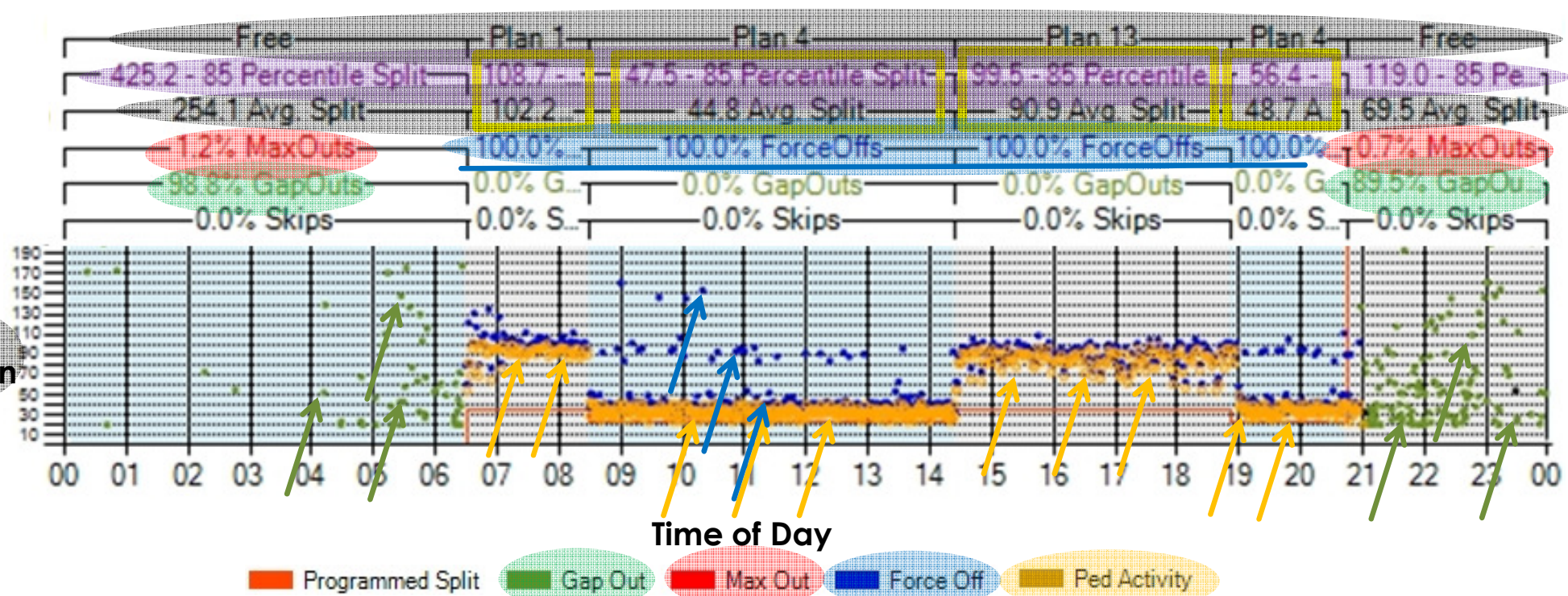
$$\frac{50\% \text{ AOG}}{75\% \text{ Green Time}} = 0.67$$

Platoon Ratio



Purdue Phase Termination Diagram

Phase
Duration



Split Monitor

What is the Best Infrastructure for Automated Signal Performance Measures?



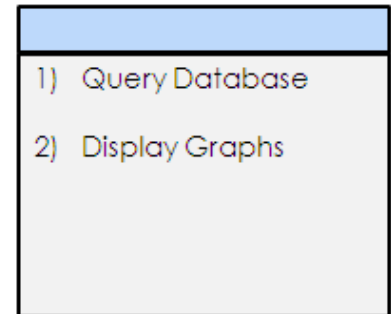
Detection



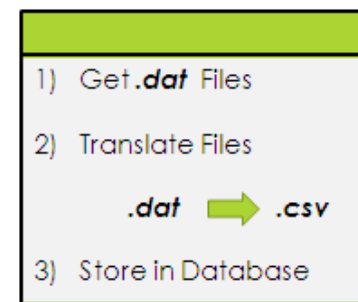
Communications



High Resolution Controller



Website



Server

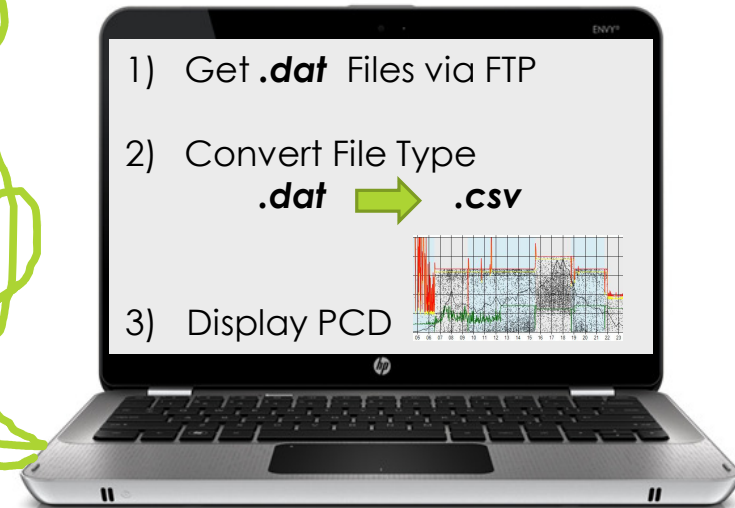
What are minimum requirements for PCD's?



**Advanced
Detection**

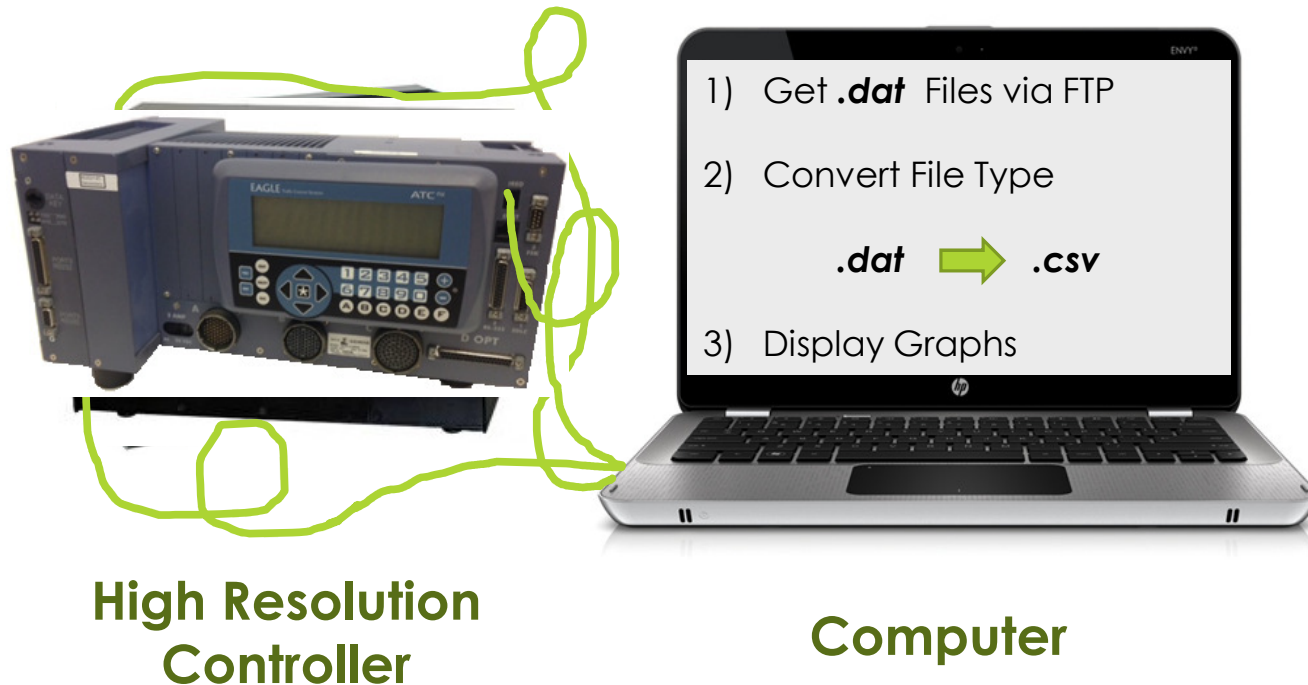


**High Resolution
Controller**



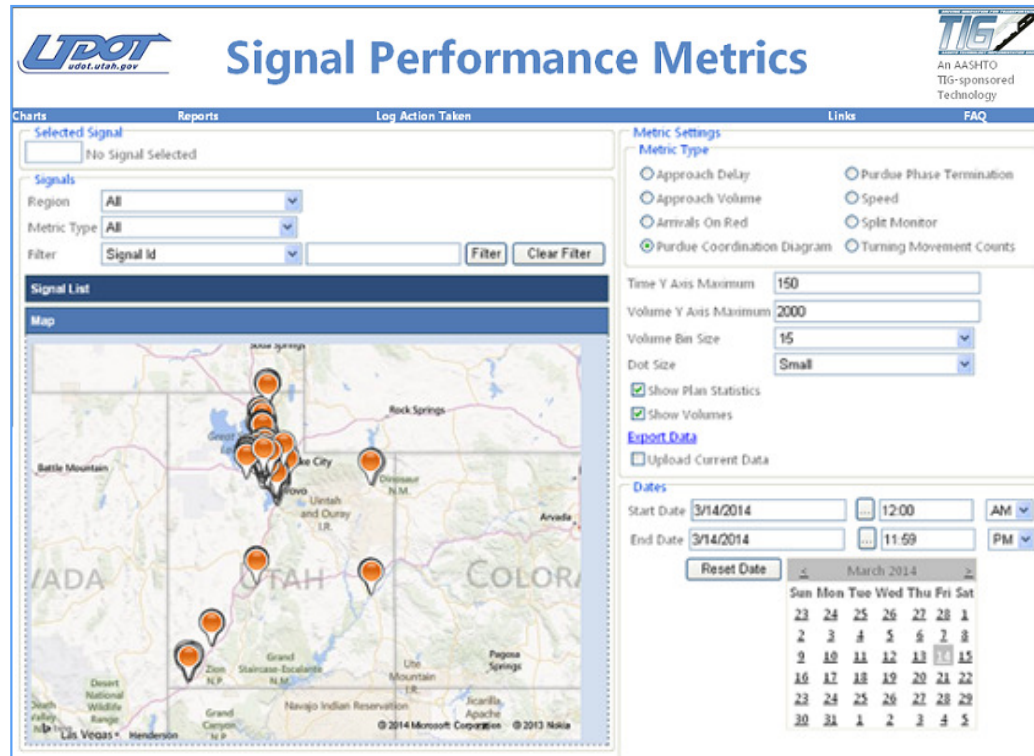
Computer

What are the minimum requirements for Automated Signal Performance Measures?



What Agency Tasks can be Automated?

- **OPTIMIZE TRAFFIC FLOW**
- **AUTOMATE REPORTS**
 - Management
 - Maintenance
 - Signal Systems Engineering
- **ARCHIVE SIGNAL DATA**
- **INFORMATION ACCESS FOR STAKEHOLDERS**
- **MONITOR SIGNAL TIMING USING THRESHOLD ALARMS**



UDOT's Signal Performance Website

“Traffic Was Bad Saturday!”

- Monday Customer Service Report

- **WAS SATURDAY TYPICAL?**
 - An accident?
 - Equipment failures?
 - Have timings changed?
 - Unusually High Volumes?
- **DOES SATURDAY NEED RETIMED?**
 - Gather Counts & Model new plan?
 - Schedule Saturday field retiming?
 - Can we fix a timing issue today?
- **NEXT SATURDAY: DID WE FIX THE PROBLEM?**

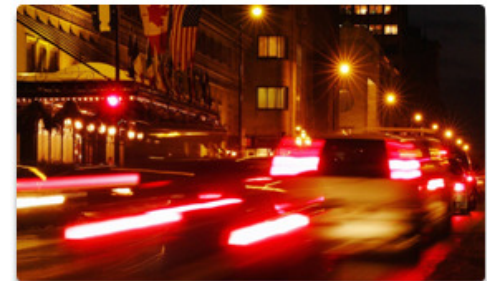
What do Automated Traffic Signal Performance Measures mean to you?



Always on...

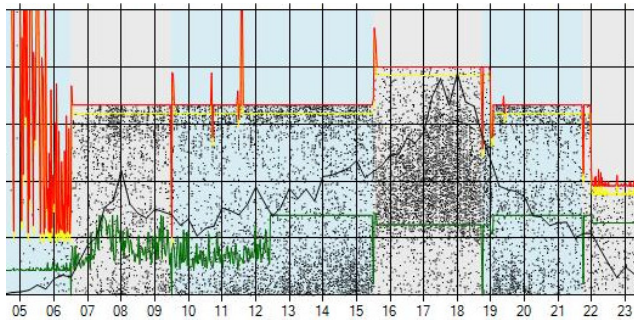


**Measure vs.
model...**



**Improved
mobility...**

Today's Goals:



**Purdue Coordination
Diagram (PCD)**



**Performance
Measures for
YOUR Agency**



Get Started!



Get Started with TIG!

- ITE WEBINAR *APRIL 9TH, MAY 7TH, JUNE 11TH*
- SERVER/WEBSITE EXPERTISE
- OPEN SOURCE CODE
- PROCUREMENT SPECIFICATION EXAMPLES



Thank you.
QUESTIONS?

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PERFORMANCE MEASURES**

